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AUTHOR Chien, Yu-Chin; Wexler, Kenneth
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ABSTRACT

A study investigated how Chinese children and adults interpreted sentences containing universal quantifiers and existential quantifiers. The purpose was to get preliminary evidence on whether Chinese children understand scope relations and whether they know which relations are possible for particular syntactic configurations. Subjects were 192 children in preschools and elementary schools in Taipei, Taiwan aged 3-10 years and 42 students attending National Chengchi University in Taipei. They acted out their interpretations of sentences involving two quantificational noun phrases (NPs). Responses given by children over age 5 showed a parallel with adult scope interpretations when constructions with two objects, one a universal quantifier-NP (Q-NP) and one an existential Q-NP, were examined. While the particular response distributions differed somewhat, all the children's behaviors except one were consistent with the adult syntactic analysis. With sentences involving two universal Q-NPs, child responses did not correspond to adult interpretations. Responses of children and adults also differed somewhat in the case of two existential Q-NPs. It is concluded that children do understand relative scope and have knowledge of the syntactic considerations determining available scope readings. Test sentences and charted results are appended. (MSE)

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CHILDREN'S KNOWLEDGE OF RELATIVE SCOPE IN CHINESE

Yu-Chin Chien
California State U. San Bernardino

Kenneth Wexler
Massachusetts Institute of Technology

In this paper, we present some results of an experiment which was designed to investigate how Chinese children and adults would interpret sentences containing universal quantifiers and existential quantifiers such as the examples given in (1) to (4). [(1) & (2) are canonical constructions; (3) & (4) are Chinese ba-constructions.]

(1) Draw a/every figure in every/a box.
(2) In a/every box draw every/a figure.
(3) Ba a/every figure draw in every/a box.
(4) Ba a/every box draw every/a figure.

According to current literature (c.f., J. Huang,1982; Lee, 1986; Aoun & Li, to appear), the scope facts concerning two quantifiers in a simple sentence do not hold across languages. In English, it is generally agreed that the scope relation of quantified noun phrases is free within the minimal sentence and thus allows various scope ambiguities. However, in Chinese, no such free property is attested. In many cases, Chinese sentences are strictly unambiguous. This cross-linguistic difference in scope relations is exhibited by the English example given in (5) and its Chinese counterpart given in (6).

(5) Every child sang a song.
(6) Meige xiaohai dou chang le yishou ge.
every-CL child all sing Asp. one-CL song
"Every child sang a song."

Sentence (5) "every child sang a song" is two-way ambiguous. It can mean that different children sang different songs where the universal quantifier NP (Q-NP) "every child" takes wide scope over the existential quantifier NP "a song". This sentence can also mean that the children all sang the same song where the existential Q-NP "a song" is said to take wide scope over the universal Q-NP "every child". The equivalent Chinese sentence given in (6), however, has only one meaning. It corresponds to the wide scope reading of the universal Q-NP "meige xiaohai". Namely, different children might sing different songs.

A rule of Quantifier Raising [as given in (7)] and two general conditions on Quantifier Raising were proposed by May (1977, 1985) to explain the scope ambiguity of sentence (5) and many other quantificational sentences. He argued that there was a level of Logical Form (LF) in syntax where generalizations concerning quantificational phenomena such as scope relations could be captured. In an LF representation, if one quantified NP c-commands the other quantified NP then the c-commanding one takes wide scope over the c-commanded one. The notion of "c-command" may be understood in the way stated in (8).

(7) Quantifier Raising Rule:
Chomsky-adjoin a quantificational NP to S.
(8) C-Command:
A c-commands B iff A does not dominate B and the first branching node which dominates A also dominates B (c.f., Reinhart, 1976).

By applying the rule of Quantifier Raising (QR) to the S-structure representation. the two quantified NPs in sentence (5) could be freely

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moved to adjoin to the S node, successively. Since there are no other conditions on the application of the QR rule nor other constraints on the output after applying this QR rule, an S-structure like (5) can be transformed into two well-formed LF representations as given in (9) and (10).

(9) $[[\text{Every child}]_i\ [[\text{a song}]_j\ [x_i\ \text{sang}\ x_j]_S]_S]_S$

(10) $[[\text{A song}]_j\ [[\text{every child}]_i\ [x_i\ \text{sang}\ x_j]_S]_S]_S$

In the LF representation (9), the universal Q-NP "every child" c-commands the existential Q-NP "a song". The universal Q-NP thus takes wide scope over the existential Q-NP and thus implies that "different children might sing different songs". In (10), on the other hand, the existential Q-NP "a song" c-commands the universal Q-NP "every child". The existential Q-NP thus takes wide scope over the universal Q-NP and implies that "the children all sang the same song".

There exist at least three proposals expressly designed to explain the scope facts of Chinese sentences. Based on a wide range of data, Huang (1982) examined quantifier scope in Chinese. He claimed that while the rule of Quantifier Raising and the notion of structural c-command were both relevant in the determination of scope relations in Chinese, the application of the QR rule in Chinese was not as free as that observed in English. In order to interpret the scope phenomena of Chinese sentences and to explain the contrast between Chinese and English as shown in examples (5) and (6), Huang proposed a general condition on scope interpretation for Chinese (1982: 220). This general rule [also known as the Isomorphic Principle], as given in (11), states that, for Chinese quantificational sentences, if a quantified NP A c-commands another quantified NP B in Surface-Structure, this quantified NP A will also c-command the quantified NP B in Logical Form. In other words, throughout the process of SS to LF mapping performed by the QR rule, the c-command relationship between two quantified NPs at S-Structure is preserved at Logical Form.

(11) Huang's General Condition on Scope Interpretation in Chinese
"Suppose A and B are both QPs or both Q-NPs or Q-expressions, then if A c-commands B at S-Structure, A also c-commands B at Logical Form"

Consider the Chinese sentence (6) again. At S-structure, the universal Q-NP "meige xiaohai (every child)" c-commands the existential Q-NP "yishou ge (one song)". According to the general constraint stated in (11), the c-command relation between these two quantified NP will stay the same in LF (after the application of the QR rule). As a result, sentence (6) is not ambiguous.

A slightly different proposal was made by Lee (1986). Following Huang's proposal, Lee argued that the hierarchical relation between two quantified NPs in a sentence was relevant for the determination of scope relations in Chinese, but instead of "c-command", the relevant hierarchical relation should be expressed in terms of "g-command". In addition, Lee claimed that both the notion of linear order and that of hierarchical relation, namely g-command, were relevant to scope interpretation in Chinese. By incorporating these two notions, Lee revised Huang's general condition for scope interpretation in the following way [see (12)]:

(12) Lee's General Condition on Scope Interpretation in Chinese
Given two quantified NPs A and B

(i) if A asymmetrically g-commands B, A will have scope over B;
(ii) if A and B g-command each other, then A can have scope over B only if A precedes B (1986: 187).
[A g-commands B iff the node representing the governing category of A dominates B, where "governing category for an element A" is defined as "the minimal category that contains A and a SUBJECT".]

In (6), the governing category for the universal Q-NP "every child" is the whole sentence which also serves as the governing category for the existential Q-NP "a song". Accordingly, these two quantified NPs g-command each other, and therefore the preceding NP "every child" takes wide scope over the succeeding NP "a song". Since in Chinese sentences such as (6), the hierarchical order of c-command is confounded with that of g-command and linear precedence, additional data besides sentence (6) are required to evaluate these two analyses suggested by Huang and Lee. [We postpone the discussion of the related data until the experimental design and the outcomes are examined.]

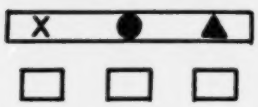
Another analysis which was proposed to account for the scope phenomena of Chinese was introduced by Aoun and Li (to appear). They challenged Huang and Lee's Isomorphic Principle by showing that there were instances in Chinese which did not exhibit this isomorphic effect. We will not discuss Aoun and Li's proposal in detail, but just want to point out that their analysis and Huang's analysis predict exactly the same results concerning the sentences tested in our experiment. In order to differentiate Aoun & Li's theory from Huang's theory, one has to consider Chinese passive constructions.

The purpose of our experiment was to get preliminary evidence on whether Chinese children understand scope relations and whether they know which relations are possible for particular syntactic configurations. For the most part linguists agree on the judgments of scope relations. However, in the one case (tested in our experiment) where Lee's model disagrees from Huang's there appears to be not complete agreement on the adult judgments. Therefore, in addition to child subjects we also tested adult subjects. Their judgments regarding this one controversial case were carefully examined. Moreover, by examining adults' data, the validity of the experimental method was assessed. Since the relationship between behavior and scope interpretation is particularly complicated (see our later discussion on "accidental" narrow scope), adult data is particularly useful when studying scope. For an earlier discussion of the acquisition of scope in Chinese, see Lee (1986).

THE EXPERIMENT

In the experiment, an act-out task was used to test Chinese-speaking children and adults' interpretation of sentences involving two quantificational NPs. The subject was first presented with a sheet of paper with an array of three equally sized squares and a card with an array of three different figures (or numbers), or a set of three markers of different colors. The subject was then presented with a test sentence (e.g., "Draw every figure in one box") and asked to perform the action prescribed in the presented sentence. An example of the layout of the experimental materials is illustrated in (13).

(13)



Sixteen different types of experimental sentences were included in this study. Half of the experimental sentences were canonical sentences [examples are given in Table 1 and Table 2]. The other half were Ba-constructions such as those illustrated in (3) & (4) above [which will not be discussed in this paper]. According to their syntactic structures, we classified the canonical sentences into two major groups. Group 1 consisted of four constructions as shown in (15) & (16) [see Table 1] and (21) & (22) [see Table 2]. These four constructions shared the structural representation given in (14) [which is repeated in (20)]. Group 2 consisted of another four constructions as shown in (18) & (19) [see Table 1] and (24) & (25) [see Table 2]. They shared the structural representation illustrated in (17) [which is repeated in (23)].

Let us first examine the structural configuration given in (14) [=(20)]. Following Huang's analysis (1982), if we assume that c-command can be relaxed to allow for an NP object of a preposition to c-command across a dominating PP node, then, in (14), NP_2 c-commands NP_1, but not vice versa. According to Huang's scope principle given in (11), NP_2 should take wide scope over NP_1. In this configuration, NP_1 and NP_2 share the same governing category, namely the S node. Thus, according to Lee, these two NPs g-command each other. Applying Lee's scope principle (given in 12) to (14) then, the preceding NP (i.e., NP_1) should have wide scope over the succeeding NP (i.e., NP_2). As mentioned earlier in this paper, Aoun and Li's analysis makes the same prediction as Huang's analysis for sentences with structure (14). According to Huang and Aoun & Li, NP_2 (i.e., y box) should take wide scope over NP_1 (i.e., x figure). Lee's analysis makes the opposite prediction.

Now consider the structural configuration given in (17) [=(23)]. In this structure, NP_1 c-commands NP_2, but not vice versa. According to Huang, NP_1 takes wide scope over NP_2. With regard to the notion of g-command, again, NP_1 and NP_2 g-command each other. In this case, since NP_1 precedes NP_2, according to Lee, NP_1 should have wide scope over NP_2. Considering the structure given in (17), a converging prediction may be derived via all three analyses mentioned.

As can be seen from the examples given in Table 1 and Table 2, besides the configurational factor, we also varied the types of quantified NPs occupying the two object positions in each sentence. We included two types of quantified NPs in this study: the universal Q-NP such as "every box" or "every figure" and the existential Q-NP such as "one box" or "one figure". In some sentences, the two quantified NPs were of the same type (e.g., sentences in Table 2); in other sentences, these two NPs were not of the same type (e.g., sentences in Table 1). Taking the order of the two quantified NPs into account, four possible combinations of these two types of quantified NPs were established: the "every-every" condition, the "every-one" condition, the "one-every" condition and the "one-one" condition. In order to facilitate comparisons among these conditions, we have included only one set of test sentences as examples here. However, in the real test conditions, three sets of test items were included. [One with the verb "hua (draw)" and the direct object NP "tuxin (figure)", one with the verb "xie (write)" and the direct object "suzi (number)", and the final set with the verb "tu (mark/color)" and the direct object "yanse (color)".] Addition of the ba-sentences yielded a total of 16 test items in each set and a total of 48 test items for each subject. The three sets of test items were randomly given to each subject.

One hundred and ninety-two children between the ages of 3 and 10, and

42 adults were tested. The child subjects were randomly sampled from preschools and elementary schools in Taipei Taiwan. The adult subjects were undergraduate students attending National Chengchi University in Taipei. The children were divided into seven age groups in one-year intervals (e.g., G1: 3-4...G7: 9-10) with at least 25 children in each group except the first two groups.

Let us first examine our adults' responses. The results concerning the eight types of quantificational constructions are summarized in Table 1 and Table 2. When adult subjects were asked to "draw one figure in every box" [e.g., (15)], about 77% of the time, they assigned wide scope (WS) reading to the existential Q-NP "one figure" and drew the same figure in different boxes. About 19% of the time, they assigned WS reading to "every box" and drew different figures in different boxes. This result, at first sight, seems to follow Lee's prediction but not the one provided by Huang or Aoun & Li. However, note that a WS reading for "every" does allow the response illustrated in (15a) where the same figure is drawn in each box. Nothing about the syntax or the scope assignment makes it necessary that a different figure be put in each box. And, in fact, Lee's analysis predicts that no instances of (15b) be found, so it remains a question why 19% exist. Thus it seems that the results given in (15a & b) are more consistent with Huang's or Aoun & Li's analysis than with Lee's.

Now, look at the result listed in (16). When adult subjects were asked to "draw every figure in one box", almost all of our subjects only assigned the WS reading to the existential Q-NP "one box" and drew all three figures in a certain box. This result, on the other hand, does follow Huang or Aoun & Li's analysis but not Lee's.

Let us examine the data listed in (18) and (19). When adult subjects received the instruction "In one box, draw every figure", with only very few exceptions, they assigned the WS reading to the existential Q-NP "one box" and drew all three figures in a certain box. This result is compatible with all three analyses provided by Huang, Lee and Aoun & Li, respectively. Now consider the data listed in (19). When adult subjects received the instruction "In every box, draw one figure", about 50% of the time they assigned WS reading to the universal Q-NP "every box" and drew different figures in different boxes. About 41% of the time, they assigned WS reading to the existential Q-NP "one figure" and drew the same figure in all three boxes. This result is compatible with all the three linguistic analyses under discussion because wide scope for the universal quantifier does not imply that there must be different figures chosen.

What preliminary conclusions can be drawn from the data just examined? The hypothesis of g-command and linear precedence (hereafter the linearity hypothesis), to a certain degree, was not confirmed by the data, while the c-command hypothesis was confirmed by the data. The experimental method seems to be valid. The question is why most of the adult responses in (15) had only one figure instead of three different ones. It seems possible that when more than one response is consistent with the syntactic analysis, the preferred response is affected by non-syntactic factors or performance considerations (as in "backward" coreference).

Let us examine the results of the sentences involving two universal Q-NPs [i.e., the every-every constructions listed in (21) and (24)] and those involving two existential Q-NPs [i.e., the one-one constructions listed in (22) and (25)]. The only correct interpretation for sentence (21) and (24) is to draw all three figures in each of the three boxes.

As indicated, about 93% of adult subjects gave the correct interpretation to these two constructions. When adult subjects were asked to draw one figure in one box, about 96% of the time they drew a certain figure in a certain box and left two figures unused and two boxes empty. When they received the instruction "in a box, draw a figure", about 76% of the time they drew a certain figure in a certain box with two figures unused and two boxes empty. About 18% of the time, they drew different figures in different boxes. In other words, they assigned the generic reading to sentence (25) and interpreted the sentence as the following: "for every x, if x=box, in x, draw one y, y=figure".

Children's responses to the eight types of quantificational constructions are illustrated in the eight figures given in Tables 1 & 2. As can be seen from the figure under (15), when children were asked to "draw one figure in every box", the WS reading was more frequently assigned to the existential Q-NP "one figure" than the universal Q-NP "every box" (excepting groups 1 & 2). The response pattern exhibited by children, older than 5, follows the same trend observed in adults. The response pattern exhibited by children younger than 5, on the other hand, does not follow the same trend observed in adults. It should be pointed out that, in the present study, a high portion of our young children tended to give only one particular response to all the test questions they had received. Therefore, the set of data obtained from children younger than 5 should be interpreted with caution.

When children were asked to "draw every figure in one box" (16), their response pattern, to a certain degree, seems to be different from the adults. Adults almost always assign wide scope to "one box", but even relatively old children (7 to 9) give almost as many responses with the 3 boxes involved as indicated in (16b). We speculate that the children might treat the PP in (14) as a sister node to NP_1, so that NP_1 and NP_2 c-command each other. Thus either responses [i.e., (16a) & (16b)] will be possible.

Let us consider the results illustrated in (18) and (19). As indicated in the figure under (18), when children received the instruction "in one box, draw every figure", most of the time, they assigned the WS reading to the existential Q-NP "one box" and drew all three figures in a particular box. Again, children exhibited a response pattern very similar to the adults' (excepting groups 1 & 2). When children received the instruction "in every box draw one figure", they assigned WS reading to the universal Q-NP "every box" more frequently than the existential Q-NP "one figure" (excepting G7). Our Group 7 children attributed the WS reading to the universal Q-NP almost as frequently as the existential Q-NP. This response pattern exhibited by children, once more, follows a similar trend observed in adults.

To summarize, if we look at the responses given by children older than 5 (i.e., our group 3 to group 7 children), a parallel between children's scope interpretation and adults' scope interpretation was found when constructions with two objects (an universal Q-NP and an existential Q-NP) were examined. The particular response distributions were somewhat different, but all the children's behaviors were consistent with the adult syntactic analysis except (16) "Draw every figure in one box." Here we speculated that the children did not have the same phrase-structure as the adults. [Note that the analysis given in (17) is not necessarily the only one. Here the PP could be attached higher up. However, there is no

possibility that the children would attach the PP under V' because complements in Chinese come on the right.]

Let us examine how Chinese children will interpret similar constructions with two universal or two existential Q-NPs. The results are given in Table 2. As mentioned earlier in this paper, the only correct interpretation for sentences involving two universal Q-NPs is to draw all three figures in each of the three boxes. However, as indicated in the figure under (21) and (24), children gave very few responses corresponding to this correct adult interpretation. In many cases, they drew a figure in a box and another figure in another box until there was no figures left and no boxes unused. Our child subjects seemed to know the concept of "every N" and tried to establish a relation between the members of the two sets of elements mentioned. However, instead of making one universal Q-NP enter the scope of another universal Q-NP, they assigned "sum of plurals" readings to (21) and (24). For example, a sum of plurals reading for (21) corresponds to the following statement "draw three figures in three boxes such that each of the figures is drawn and each of the boxes is drawn in." An alternative interpretation to this set of results is that children may produce this strikingly different result because of some kind of response set, namely, they did not want to use any figure more than one time. Our intuition is that this is an unlikely interpretation, especially given the older age at which children still produced this result. Obviously future research is necessary. However, if this response pattern is upheld, and is seen to be a result of children's syntactic knowledge (and not an artifact) then it seems that it is an important empirical discovery which calls out for theoretical explanation. It might be central to a discussion of the acquisition of operators in child language.

When child subjects were asked to draw one figure in one box, in most of the cases, they drew a certain figure in a certain box and left two figures unused and two boxes empty. When they received the instruction "in one box, draw one figure", the same response pattern was observed. They drew a certain figure in a certain box with two figures unused and two boxes empty. Similar to the adult subjects, in some cases our child subjects also assign the generic reading to sentences containing two existential Q-NPs. However, they did so to both sentence (22) and sentence (25), while adult subjects only assigned the generic reading to sentence (25) but not sentence (22). A fuller discussion and understanding of these and other results awaits further investigation. At any rate, we have provided evidence that children understand relative scope and have knowledge of the syntactic considerations which determine available scope readings.

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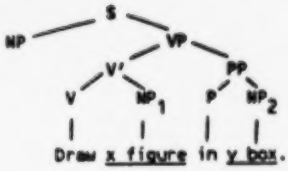
We would like to thank James Huang, Audrey Li, Barbara Lust and James Gair for their useful comments.

Table 1

The Test Sentences and the Results

(14)



PREDICTIONS

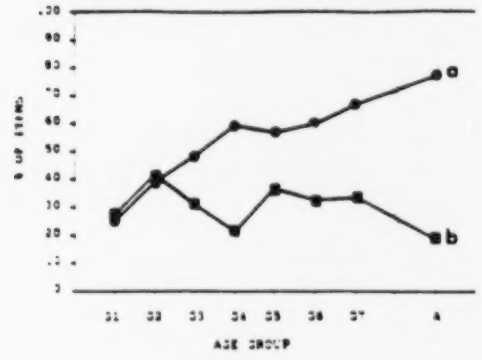
Huang: y box has wide scope over x figure.
Lee: x figure has wide scope over y box.
Aoun & Li: y box has wide scope over x figure.

RESULTS

(15) Hua yige tuxin zai meige gezi li.
Draw one-CL figure at every-CL box inside
"Draw one figure in every box."

a. [X] [X] [X] Adult: 76.98%

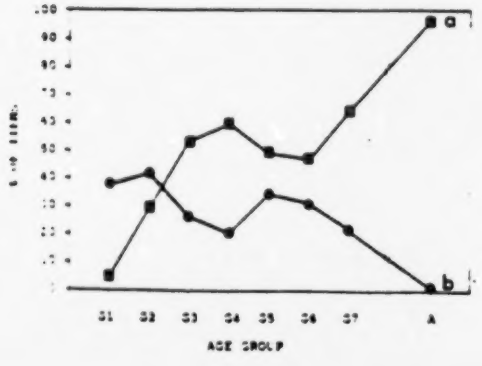
b. [X] [●] [▲] Adult: 19.05%



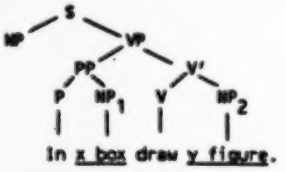
(16) Hua meige tuxin zai yige gezi li.
Draw every-CL figure at one-CL box inside
"Draw every figure in one box."

a. [X▲] [ ] [ ] Adult: 96.03%

b. [X] [●] [▲] Adult: 0.79%



(17)



PREDICTIONS

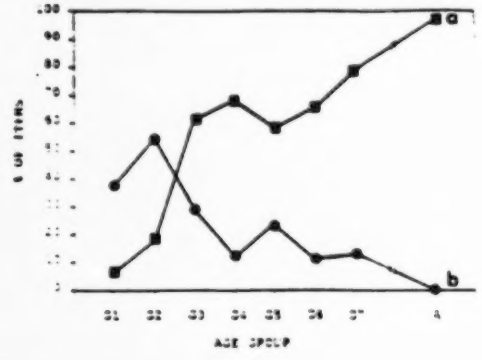
Huang: x box has wide scope over y figure.
Lee: x box has wide scope over y figure.
Aoun & Li: x box has wide scope over y figure.

RESULTS

(18) Zai yige gezi li hua meige tuxin.
At one-CL box inside draw every-CL figure.
"In one box draw every figure."

a. [X▲] [ ] [ ] Adult: 96.83%

b. [X] [●] [▲] Adult: 0.00%



(19) Zai meige gezi li dou hua yige tuxin.
At every-CL box inside all draw one-CL figure
"In every box draw one figure."

a. [X] [●] [▲] Adult: 50%

b. [X] [X] [X] Adult: 41.27%

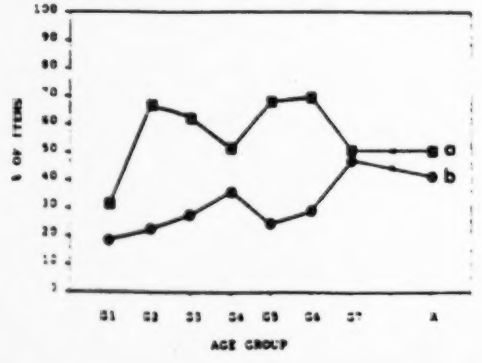
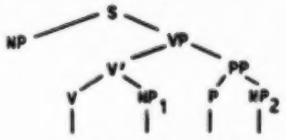


Table 2

The Test Sentences and the Results

(20)



Draw x figure in y box.

PREDICTIONS

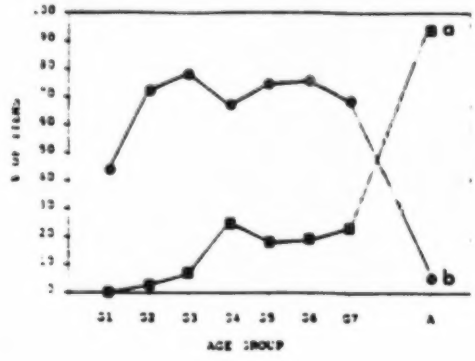
Huang: y box has wide scope over x figure.
Lee: x figure has wide scope over y box.
Aoun & Li: y box has wide scope over x figure.

RESULTS

(21) Hua meige tuxin zai meige gezi li.
Draw every-CL figure at every-CL box inside
"Draw every figure in every box."

a. b.

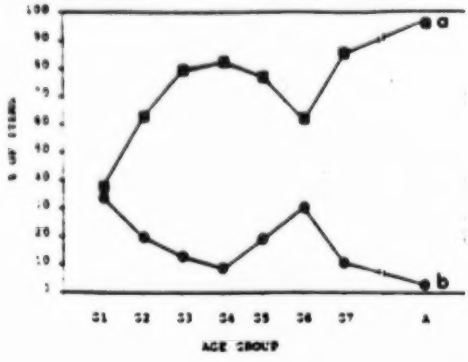
Adult: 93.65% Adult: 4.76%



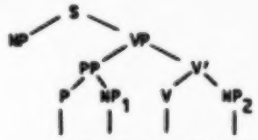
(22) Hua yige tuxin zai yige gezi li.
Draw one-CL figure at one-CL box inside
"Draw one figure in one box."

a. b.

Adult: 96.03% Adult: 2.38%



(23)



In x box draw y figure.

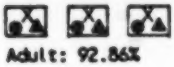
PREDICTIONS

Huang: x box has wide scope over y figure.
Lee: x box has wide scope over y figure.
Aoun & Li: x box has wide scope over y figure.

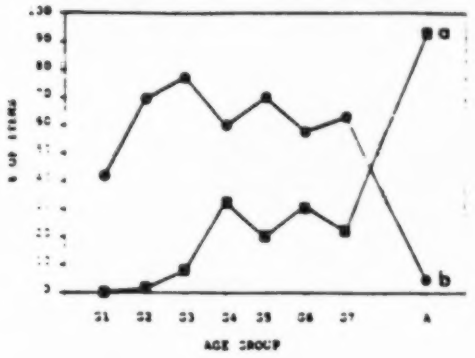
RESULTS

(24) Zai meige gezi li dou hua meige tuxin.
At every-CL box inside all draw every-CL figure
"In every box draw every figure."

a. b.

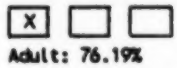


Adult: 92.86% Adult: 4.76%



(25) Zai yige gezi li hua yige tuxin.
At one-CL box inside draw one-CL figure
"In one box draw one figure."

a. b.



Adult: 76.19% 18.25%